

U.S. NAVAL BASE, PEARL HARBOR, SAWMILL
(U.S. Naval Base, Pearl Harbor, Naval Shipyard, Facility No. 154)
Seventh Street near Avenue E
Pearl Harbor
Honolulu County
Hawaii

HABS HI-495
HI-495

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN BUILDINGS SURVEY
PACIFIC GREAT BASIN SUPPORT OFFICE
National Park Service
U.S. Department of the Interior
1111 Jackson Street
Oakland, CA 94607

ADDENDUM TO:
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FIELD RECORDS

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**Addendum To
U.S. NAVAL BASE, PEARL HARBOR, SAWMILL
(U.S. Naval Base, Pearl Harbor, Naval Shipyard)
(Building No. 154)
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HISTORIC AMERICAN BUILDINGS SURVEY

**Addendum to
U.S. NAVAL BASE, PEARL HARBOR, SAWMILL
(U.S. Naval Base, Pearl Harbor, Naval Shipyard)
(Building No. 154)**

This report is an addendum to a nine page report previously transmitted to the Library of Congress.

Location: Seventh Street near Avenue E

Ford Island
City and County of Honolulu, Hawaii

Significance: Building No. 154 is significant as a part of the build-up of Pearl Harbor Navy Base as the United States prepared for World War II. It is part of an extant group of shop buildings, from that era and earlier, which are associated with woodworking. Building 154 contained a large 4-section dust-collection system of remarkable design which efficiently extended to nearby wood shop buildings. It employed a cyclone separator to clean the air stream from the farthest reaches of the system.

Description: For a detailed description of Facility 154 see HABS No. HI-495.

Historical Context: Refer to HABS No. HI-483 for an overview of the history of the Pearl Harbor Naval Shipyard. For additional information on the group of wood shop buildings see HABS No. HI-486 (Building 7), HABS No. HI-447 (Building 12), HABS No. HI-463 (Building 14), and HABS No. HI-464 (Building 15).

Building No 154 was built as an "Additional Woodworking Shop."¹ It was constructed under Navy contract NOy-4173 to the Contractor's Pacific Naval Air Bases (CPNAB), which was a consortium of firms which were first awarded contracts on August 5, 1939 to construct bases in the Pacific.² This building was completed by early 1941. An aerial photo dated January 7, 1941 shows the finished roof³ and a ground-level photo dated February 12, 1941 (see page 22 of this report) shows the completed building, described as "new woodworking shop."⁴

When Building 154 was built, a large conical-shaped incinerator was installed behind (east) of it to burn the waste wood chips from the shop (See page 27 of this report).⁵ Mounted on the upper portion of the

¹ Naval Facilities Engineering Command (NAVFAC) Pacific Division: Plan files drawings numbered 143822 to 143826. September 24, 1940.

² Bureau of Yards and Docks, *Building the Navy's Bases in World War II: History of the Bureau of Yards and Docks and the Civil Engineer Corps, 1940-1946, Vol. I*, (Washington D.C.: U.S. Government Printing Office, 1947), 115

³ National Archives and Records Administration (NARA), Photograph 115314 in RG 71 CA 171B, January 7, 1941.

⁴ NARA, Photograph 14121 in RG 71 C/ Box 178, Folder Z 12, February 12, 1941.

⁵ (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-396, August 5, 1941.

incinerator was a cyclone separator which fed wood chips into the incinerator. Shortly after Building 154 was built, its dust collection system was extended to Building 14, and a few months after that it was extended to Building 7, across Seventh Street. Along with the extension of the dust collection system to Building 7, a second cyclone collector was added on the roof of Building 154 which received the dust and wood chips from Building 7. This roof-top cyclone cleaned the air stream from Building 7 and deposited the separated wood chips into the ductwork of Building 154 to be taken to the cyclone separator at the incinerator and then burned.

Cyclone design and operation.

A cyclone separator is a device which cleans (separates) solid particles out of air (or liquid) streams. A common design, and the one originally used on the roof of Facility 154, is the tangential inlet axial discharge-type. It is an inverted conical-shaped (funnel-shaped) settling chamber that uses centrifugal force and a vortex to take heavier particles out of the stream. This type of cyclone consists of a hollow cylinder which has an inlet duct positioned tangentially. The inlet duct is usually rectangular to eliminate unwanted turbulence in the cyclone by imparting a laminar flow to the air stream.⁶ Below this cylinder is a funnel-shaped chamber with a discharge chute at its bottom end. Centered at the top of the cylinder is the outlet (overflow) pipe. A section of this pipe protrudes down into the cylinder to form a sleeve or vortex finder. The vortex finder extends below the inlet duct to stop the inlet air stream from blowing directly up the outlet.⁷

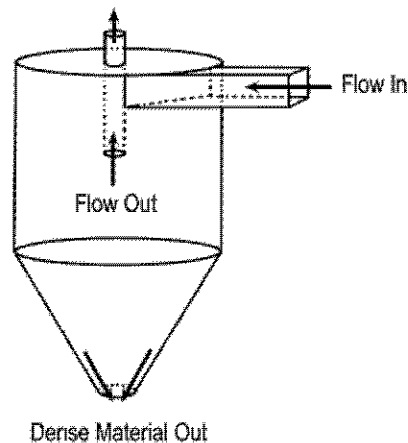


Fig. 1. Cyclone separator.

Cyclone separators have been used in wood shops for removing dust for at least seventy years.⁸ Wood shop cyclones are essentially agricultural

⁶ Steve Silca, *Cyclone*, n.d. available from www.studio1304.com/silca/cyclone/cyclone.htm, accessed January 5, 2007, 7. And William F. Pentz, *Cyclone Dust Collector Research & Equipment*, 2003, available from <http://billpentz.com/woodworking/cyclone/Equipment.cfm>, accessed on January 2, 2007, 24.

⁷ Herman F. Mark et al., eds., *Kirk-Othmer Encyclopedia of Chemical Technology*, Third Edition, Volume 1, (New York: Wiley, 1978), 669.

⁸ Pentz, *Cyclone Dust Collector*, 11.

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cyclones which have been in use even longer for such tasks as separating chaff from grain, and sand from cotton fiber. The first cyclone separator in the United States dates from 1885. This was a tangential inlet/ axial discharge-type design⁹ for dust separation. This device, covered under U.S Patent 325,521, was invented by John M. Finch and was produced by the Knickerbocker Company of Jackson, Michigan.¹⁰

In a cyclone separator, the incoming, particle laden air enters through the inlet duct, striking the curved interior of the cylinder which creates a vortex by causing the air stream to spin around the inner surface of the cylinder. Denser, heavier particles are forced against the interior wall of the cylinder by centrifugal force because they have too much mass and inertia to follow the tight spiral of the air stream. They spin downward as the vortex carries them along the sloping sides of the funnel beneath the cylinder to where, slowed by the drag of the spiral air flow and pulled by gravity, they drop through the discharge chute at the bottom. Usually a collection bin is below the discharge chute to gather the particles. As the air stream travels the distance down the side of the funnel, its force (velocity) is reduced. At the same time the narrowing of the funnel creates a rise in the pressure of the air stream. These two factors combine to reverse the flow of the particle-free air stream, forming another vortex going up the center of the funnel. As the rising vortex reaches the cylinder, it avoids the turbulent area near the inlet by entering the downward protruding vortex finder and is routed out the top of the separator.

The separating ability of a cyclone is dependent on its proportions, air flow rate, and its pressure drop between the inlet and overflow. Variations in the diameter, length, and angle of the cylinder and funnel will give different characteristics to the air stream, resulting in a variation in the particle size that the cyclone can separate out. If parameters are exceeded, problems can develop that will prevent the cyclone separator from functioning properly. If the funnel is too long the cyclone can plug because of the airflow preventing the dust from dropping. Too short of a funnel can cause the vortex to dip into the collection bin and suck up particles. A funnel that is too wide or narrow can create a wandering vortex which will snatch particles off the funnel wall and carry them out the overflow.

Increasing the pressure drop between the inlet and overflow, yields a cleaner overflow by capturing smaller particles. Using two or more cyclone separators in series can also serve to separate progressively finer particles out of the air stream. Generally, the larger the diameter of a cyclone separator, the larger (denser) the particle it is designed to capture.

Smaller diameters and higher heights will increase a cyclone's efficiency, capturing smaller particles. The normal height of a cyclone is generally

⁹ Mark et al., *Chemical Technology*, 667.

¹⁰ John M. Finch, Patent 325,521, Dust Collector, (U.S. Patent Office, 1885).

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two to six times its diameter, with the angle of the funnel apex between 10 and 20 degrees. Smaller angles are generally used on high efficiency cyclones to separate out smaller particles.¹¹

The separating ability of a cyclone separator is termed its cut point. This is the particle size whose concentration the cyclone can reduce by 50% from the inlet to outlet streams. More than 50% of particles larger than the cut point will be removed and less than 50% of smaller particles will be removed.

The Dust Collection System in Building 154.

The dust collection system in Building 154 was installed when the building was constructed, about January, 1941. This original system consisted of two fans, each of which serviced about half of the building via each fan's inlet duct. Fan #1 was located near the center of the building and it serviced the west half of the building, fan #2 was located just inside the east end wall servicing the east end of the building. The fans and their motors were mounted on a wood framework suspended from the roof trusses. Ductwork was routed either just below the roof trusses or through them. The fans were each driven by a 125 horsepower electric motor which revolved at 720 rpm.¹² The fans had an air capacity of 30,000 cfm¹³ (see page 25 of this report). The inlet ducts at each fan, 32" in diameter at fan #1 and 36" in diameter at fan #2,¹⁴ were reduced down progressively as the duct extended further from the fan to a diameter of 7" (fan #1) and 8" (fan #2).

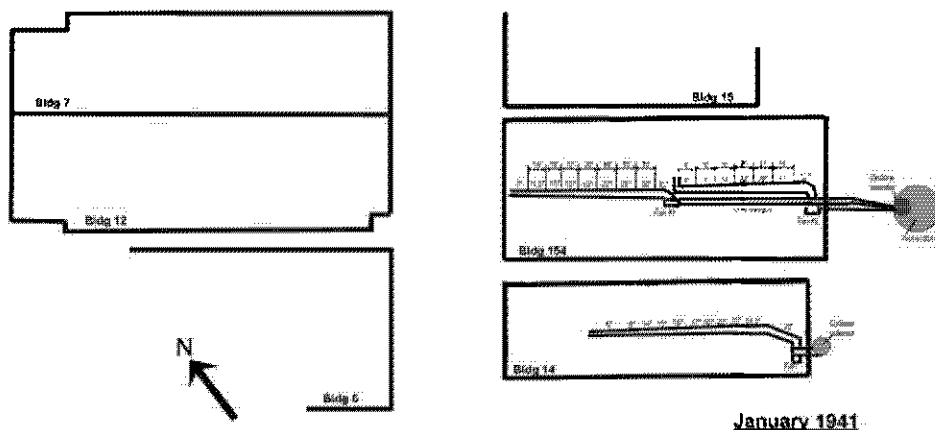


Fig. 2. Dust collection system ca. January 1941.

The various woodworking machines and floor sweeps were connected via (5" to 8" diameter) ducting to these inlet ducts as they extended along the length of Building 154. The outlet duct of each fan was 32" in diameter.

¹¹ Mohamed Diarra, Steve Davis, and Lee Heathman, "Cyclone Separators," paper prepared for Washington State University class, Agricultural Processing 433, 1996, available from www.wsu.edu/8080/~gmhyde/433web-pages/cyclones-CycloneOverview.htm accessed on January 3, 2007.

¹² (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-322, January 31, 1941.

¹³ (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-306, December 17, 1940.

¹⁴ (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-322, January 31, 1941.

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The outlet ducts extended eastward, out the rear end of the building, to a cyclone separator that was mounted near the top of the incinerator. This cyclone separator removed the wood chips from the air stream and fed them, via the discharge chute at the bottom, directly into the incinerator. The air stream (with uncollected fine dust) was vented out the overflow (outlet) at the top of the cyclone into the air above Building 154.

The design of the incinerator is not known. It is likely that it was a rudimentary fire brick-lined combustion chamber that was set over an ash pit. A metal grate at the bottom of the combustion chamber would have supported the burning material. The incinerator was about 40' in diameter at its base and about 60' high. The wood chips were loaded into the incinerator directly from the discharge chute of the cyclone separator at a point about 25' above the base¹⁵ (see page 26 of this report). The incinerator would have had another opening in its side near the bottom for removing clinkers and ash.

Very shortly after Building 154 was built, about March 1941, its original dust collection system was expanded to service the pattern shop next door, Building 14. At that time the pattern shop had a dust collection system of its own which included a cyclone separator just outside the rear (east) of the building that received the air stream from a fan mounted inside the east wall, on the second floor of the building. This fan had a 26" diameter outlet duct leading to the cyclone, and a 26" diameter inlet duct which was routed along the ceiling of the first floor, reducing down progressively to 6" diameter at its end.

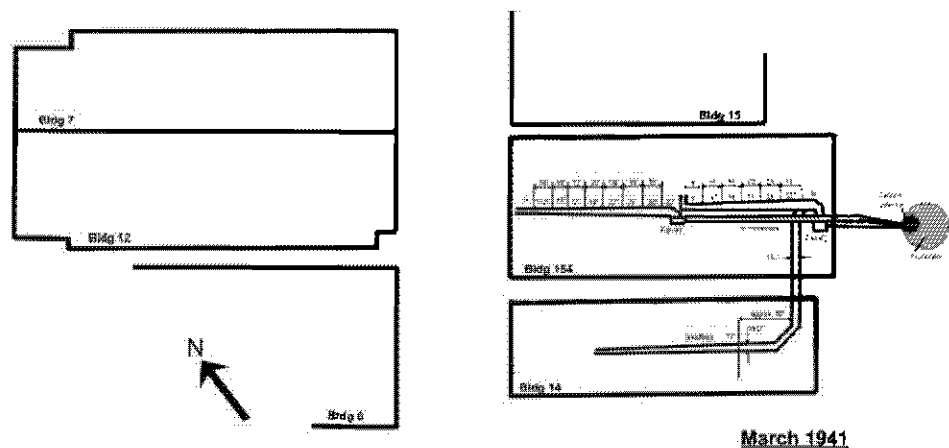


Fig. 3. Dust collection system ca. March 1941.

The March 1941 modification to the dust collection system removed the cyclone collector and fan at Building 14 and connected that building's existing ductwork, via an 18" diameter duct, to the inlet duct of fan #2 in Building 154, which was enlarged to 36" to accommodate the increased load. The 18" diameter duct was routed just above the bottom of the roof trusses of Building 154, across the space between the buildings about 22'

¹⁵ (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-318, January 31, 1941.

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above the rail tracks, and into Building 14 just below the first floor ceiling. The 18" duct connected to the existing ductwork of Building 14 at a point where the existing inlet duct was 17½" in diameter, about 50' west of where it entered the building.

Between August 22 and October 13, 1941 the dust collection system was expanded again to add the woodworking shop, Building 7, located to the northwest of Building 154, across Seventh Street. For this addition a fan in Building 7 gathered the wood dust and chip-laden air stream from that building, sending it to Building 154 via a 30" diameter outlet duct that was suspended 41'-3" above the street by ¾" diameter galvanized steel cables. At Building 7, the cables were secured to the metal framework of the building. The 30" duct entered Building 154 through the east gable-end wall just below the roof monitor. This duct was connected to the outlet of a fan just below the ceiling of the first floor. Connected to the 28" inlet diameter of this fan was a section of 31" diameter inlet duct which was routed down the length of Building 154, just below the first floor ceiling. This inlet duct reduced in stages to 8" at its far end and was connected to the various woodworking machines in Building 154. Several of the woodworking machines served by this system; band saw, shaper, and planer, were located in the boat shop (Building 12) which was connected to the south side of Building 7.¹⁶

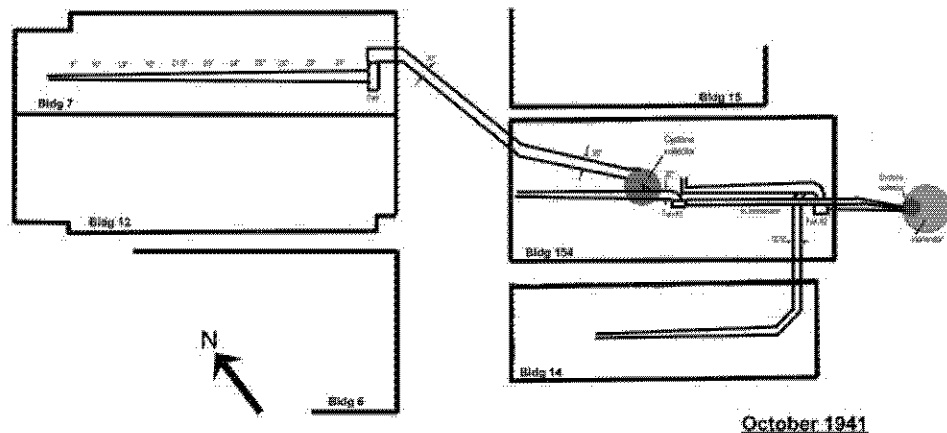


Fig. 4. Dust collection system ca. October 1941.

On the east side of Seventh Street, at the roof of Building 154, the 30" outlet duct from the Building 7 fan and its steel suspension cables were supported by a 22'-10" high wood framework that was constructed of 8" x 8" posts and diagonal members, 3" x 10" and 3" x 12" beams, and 3" x 8" cross braces. The framework supported the duct about 14' above the west eave of Building 154. The suspension cables were routed over the top of this framework to backstays on the roof of the building. From this framework the 30" duct extended eastward, supported above the roof of Building 154 by a series of wood pipe supports that were each positioned above a transverse roof truss. A narrow walkway of wood boards ran

¹⁶ (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-397, August 5, 1941.

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next to this elevated section of the duct. The 30" duct fed the chip-laden air stream into the top of a cyclone separator which was mounted above the roof of Building 154, near its center point. The cyclone was supported by a metal framework, its top about 26' above the roof. The discharge chute at the bottom of the cyclone was a section of 12" diameter metal tube which extended through the roof into the building below. Instead of ending in a collection bin below the discharge chute, wood chips separated from Building 7's air stream by the cyclone were injected into the existing dust collection system of Building 154 to be carried to the cyclone at the incinerator, separated out of the air stream again, and burned. The chips fell from the roof-top cyclone into a 4' diameter funnel that was positioned beneath the chute. From the funnel, the chips traveled through a 12" diameter pipe which elbowed into the existing inlet duct of Building 154's fan #1 at a point where the duct was 30" in diameter. The overflow at the top of this roof top cyclone, like the cyclone separator at the incinerator, vented the fine dust not removed from the air stream into the air above Building 154. The cyclone separator on the roof and its supporting frame were built by the Northwestern Blower Company of Seattle¹⁷ (see page 27 of this report).

Although the use of two cyclone separators in series can serve to separate progressively finer particles out of the air stream, this was not the reason for using the roof-top cyclone. It was likely that this arrangement served to efficiently span the long distance (up to 600') from the woodworking machines in Building 7 to the incinerator behind Building 154. The separate section of the system which used the fan at Building 7 would not have to rely on air flow generated by a fan in Building 154. The wood chips separated by the roof-top cyclone would have entered the section of the system served by Building 154's fan #1 just as if they were generated by a machine in that building. In addition, removing the dust from the air stream by the roof-top cyclone prior to entering Building 154's system would decrease the amount of material that it had to carry back to the cyclone at the incinerator.

A further alteration was made to the dust collection system about August 1943. Building 14, the pattern shop south of Building 154, got its own fan and was connected directly to the cyclone separator at the incinerator. This was accomplished by severing the existing 18" diameter ductwork in Building 14 at a point near where it entered the building. The existing ductwork which was servicing the woodworking machines in the building remained and was connected to the inlet of the new fan that was installed on the second floor above the point where the duct was severed. The 18" diameter duct servicing the machines was routed up through the ceiling of the first floor and connected to the fan on the second floor. The new fan in Building 14 was powered by a 40hp electric motor and was rated at 13,275 cfm.¹⁸ The 20" diameter outlet of this fan was routed out the north side wall of Building 14 and across to Building 154 about 22' above the

¹⁷ (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-396, August 5, 1941.

¹⁸ (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-872, July 24, 1943.

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rail tracks. The 20" duct was elbowed east after entering Building 154. At the rear of the building it inclined upward to the inlet of the cyclone separator which fed the incinerator.

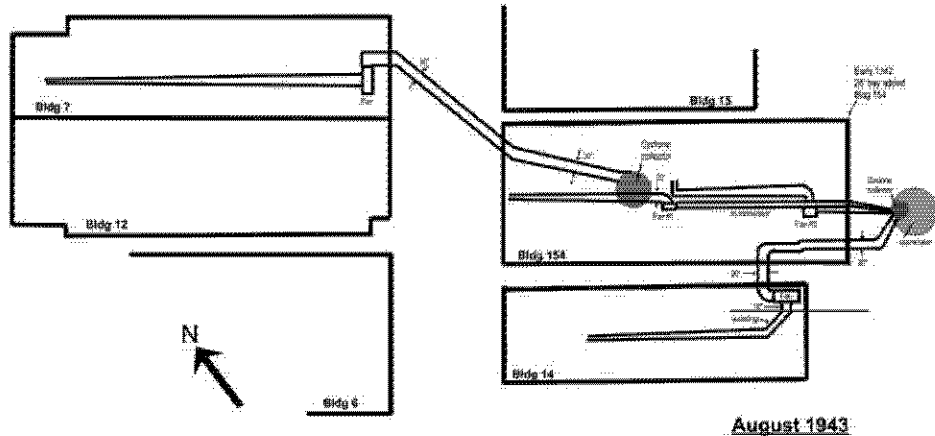


Fig 5. Dust collection system ca. August 1943.

Apparently, this 1943 alteration was accomplished to improve the dust collection efficiency of the system in Building 14 by removing the building from the fan #2 section of Building 154 and adding a dedicated fan for Building 14. This did not seem to be enough of an improvement. In 1944 the system in Building 14 was enlarged with a 75 hp-driven fan that was rated at 27,800 cfm and all new ductwork with a 34" inlet duct to the fan.¹⁹ This inlet duct served the machines in Building 14 and tapered down to 8" diameter at its far end. The outlet duct of the new fan was 32" and led to the cyclone collector and the incinerator.

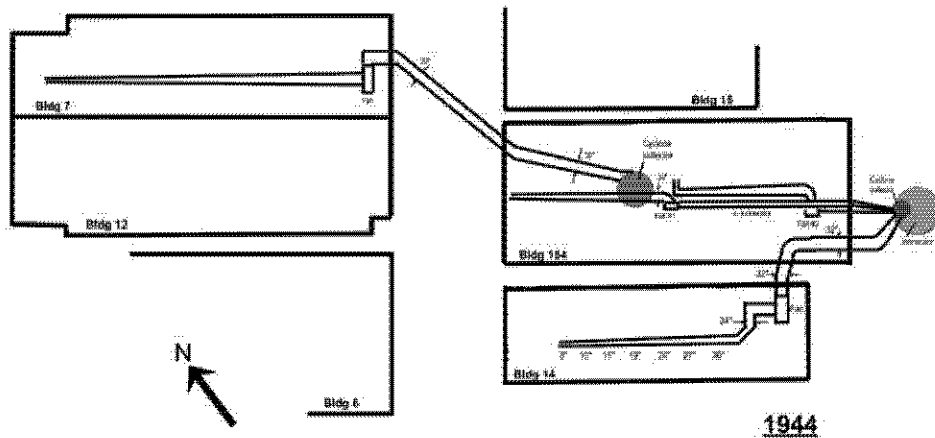


Fig. 6. Dust collection system ca. 1944.

In 1972 the incinerator behind Building 154 was removed and in its place a large cyclone separator with a collection bin was installed. This cyclone may have been the existing one (mounted next to the incinerator to

¹⁹ (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-979, March 13, 1944.

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separate chips for burning) that was re-configured by the addition of a collection bin and a new support framework²⁰ (see page 26 of this report). The cyclone separator was approximately 30' high, with a cylinder diameter of about 15'. At the top of the cyclone, the air stream outlet was a section of large diameter round duct (about 7' in diameter) formed in to a 90° bend to vent the fine dust that was not collected into the air above Building 154. The discharge chute of the cyclone was fitted to the top of a large square collection bin, measuring about 12' on a side and about 22' in total height. At the lower portion of the collection bin, the four sides sloped inward to empty into a movable receptacle beneath it. The cyclone separator and its collection bin were supported on a framework of four metal uprights with diagonal bracing. A metal ladder at the west side of the cyclone provided access to a walkway set at the top of the four metal uprights. The walkway surrounded the cyclone near the top of its funnel-shaped settling chamber, about 50' above grade. The overall height of the cyclone separator, discharge chute, and its collection bin was approximately 70'.

Building Alterations

The additional woodworking shop, Building 154, was originally constructed with a length of 256'-0". This was twelve 16'-0" wide bays with two 32'-0" wide bays at its east end.²¹ During 1942 a third 28'-0" wide bay was added to the east end of the building (Furlong 1943). Alteration drawings that show a "28 ft extension" are dated December 30, 1941.²² This extension of the building housed a 42 inch band saw.

Sources:

Early Views:

Historic photographs of the interior of a machine inside Building 154 and of the dust collector atop the incinerator in 1944 were located at the Hawaii State Archives, Admiral Furlong Collection call # PPFUR, box 1, folder 29 "Navy Yard Workers." Aerial views of Building 154, dust collector, incinerator, and adjacent buildings were located at the Hawaii State Archives, Admiral Furlong Collection call # PPFUR, box 2, folders 1, 2, and 3 "Pearl Harbor Aerial." Photographs in this collection were created by a U.S. federal agency (U.S. Navy) and are considered in the public domain.

Additional historic photos are located in the NAVFAC Archives in Port Hueneme CA.

²⁰ (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-318, January 31, 1941.

²¹ (NAVFAC) Pacific Division: Plan files drawing numbered 143823, September 2, 1941 and NARA, Photograph 115314 in RG 71 CA 171B, January 7, 1941..

²² (NAVFAC) Pacific Division: Plan files drawing numbered I-N5-446 to I-N5-449, December 30, 1941.

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Photograph folder PPFUR 1-2 "Pearl Harbor aerial 1935, 1942-43" #23293, December 12, 1943. Furlong Collection at the Hawaii State Archives.

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Photograph RG 71 CA/Box 178 folder Z 12 February 1941, #14121

Naval Facilities Engineering Command Archives.

Historic photo 5-23-49 #82 from box TI 1/4 folder "Marine Barracks, Aerial coverage." Port Hueneme, CA. May 23, 1949.

Naval Facilities Engineering Command, (NAVFAC) Pacific Division. Plan Files Database.

Drawings for Building No. 154. Pearl Harbor, HI. Various dates.

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Pearl Harbor Shipyard.

Photographs from collection of shipyard photo lab. 16 January 1944 & March 1980 (#VSJ-74-3-80 F146).

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Cyclone. www.studio1304.com/silca/cyclone/cyclone.htm n.d. Accessed on January 5, 2007.

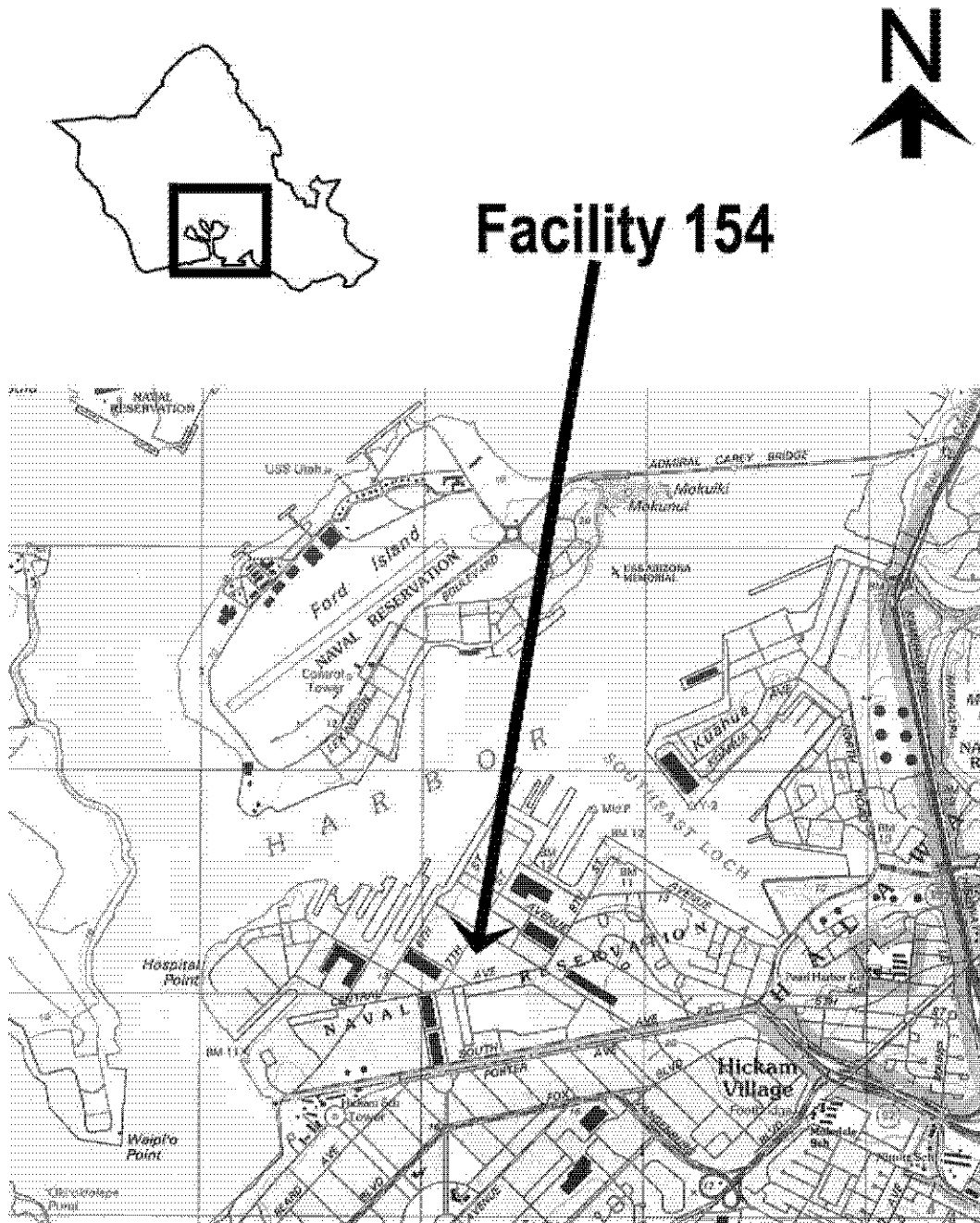
Project Information: This addendum was prepared because of planned alterations to Building 154, including the removal of its dust collection system and the system connections to the adjacent buildings. The dust collection system is considered a character defining feature. Commander Navy Region Hawaii and other Navy activities in Hawaii are required under Section 110 of the National Historic Preservation Act of 1966, as amended, to initiate measures to make appropriate records of historic properties that would be substantially altered or demolished as a result of Navy action. Mitigation for demolition or extensive alteration under Section 106 sometimes requires amending and adding photographs to existing HABS reports according to National Park Service guidance. This report was researched and prepared by Dee Ruzicka of Mason Architects, Inc. Honolulu, HI.

Prepared by:

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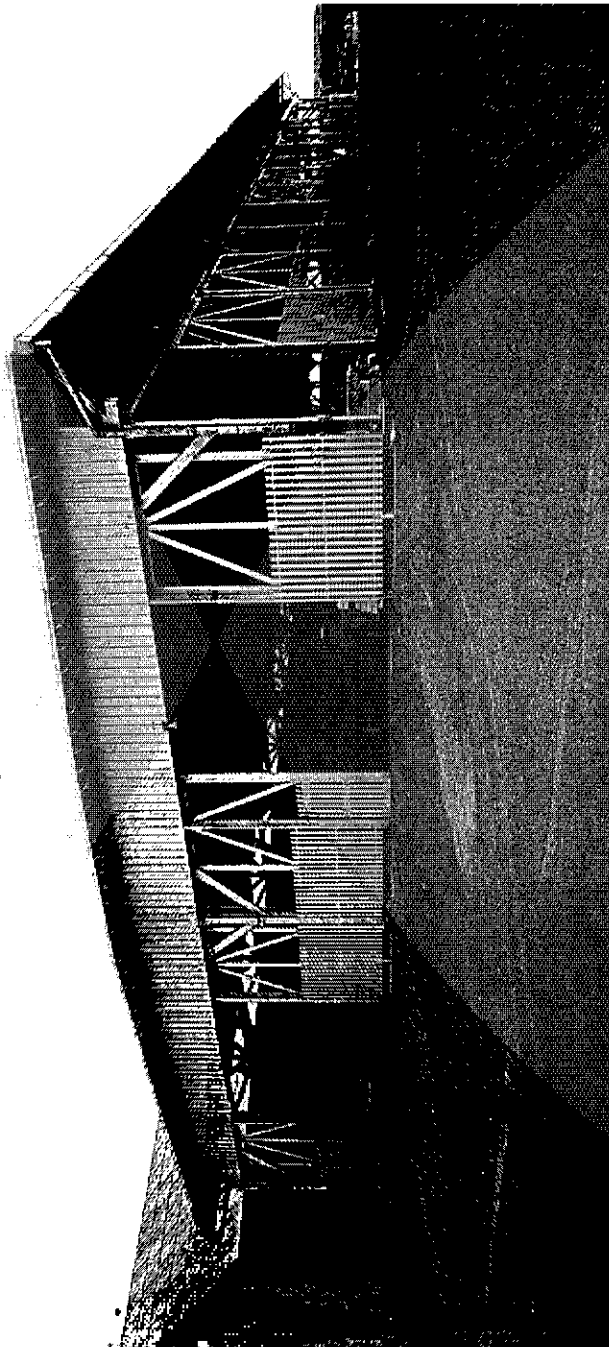
Date of Report: February 2009

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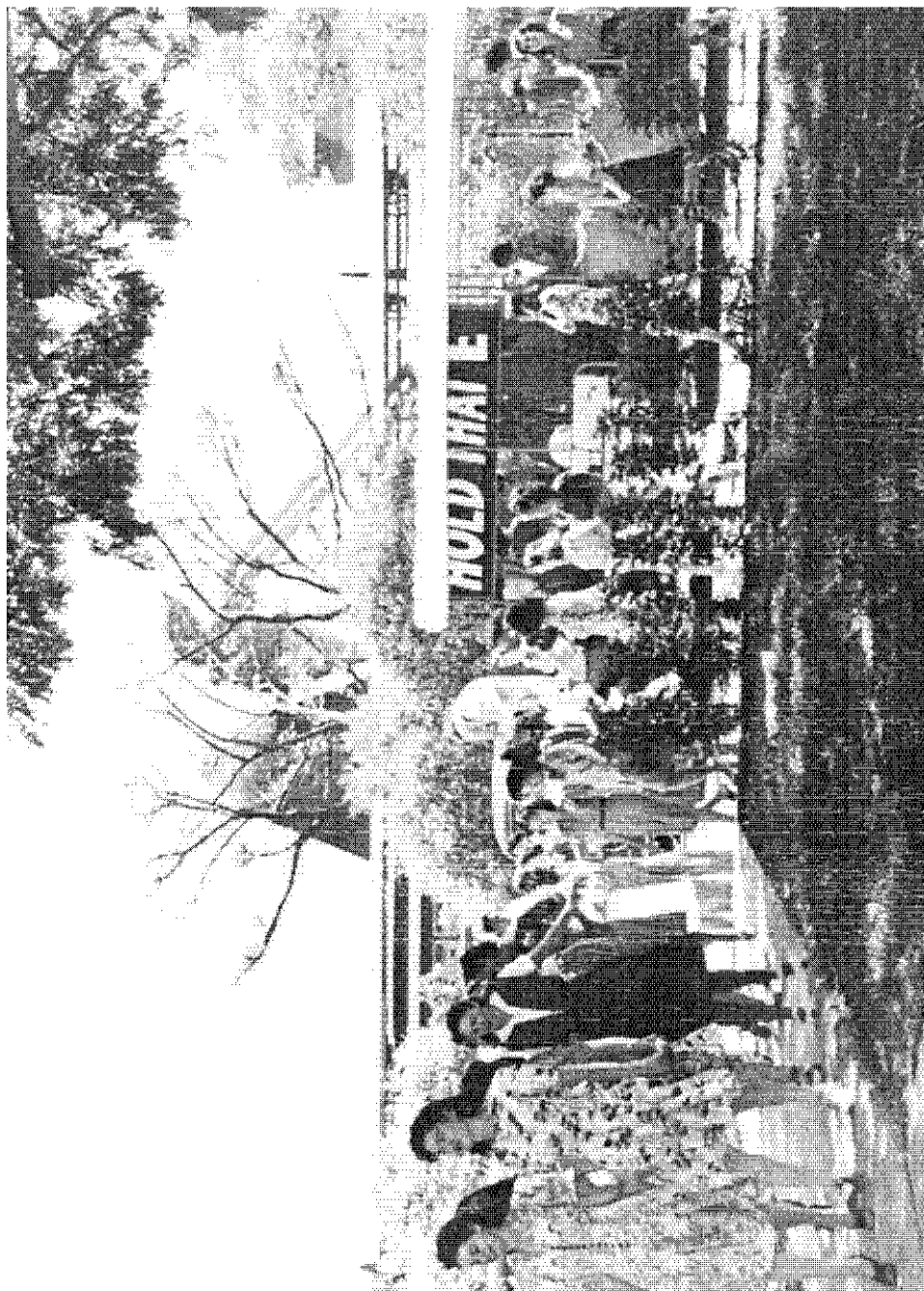
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Portion of photograph dated 12 February 1941 showing the "Additional Woodworking Shop" Building 154. View looking east. NARA photo 14121, 12 February 1941.



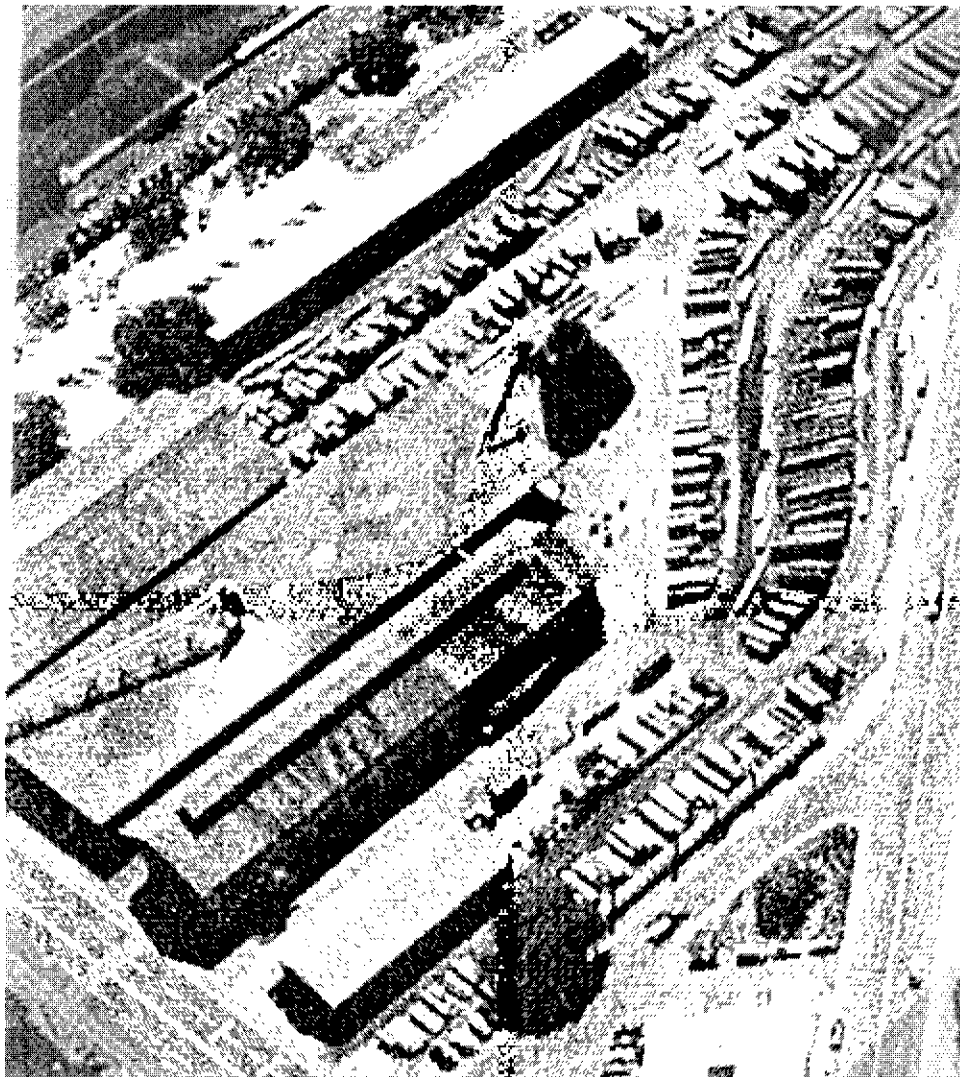
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Portion of photograph dated 1944 showing (in background above trolley) the upper portion of the incinerator behind Building 154 and its cyclone collector with ductwork. View looking south. Furlong 1944, PP FUR 1-29.



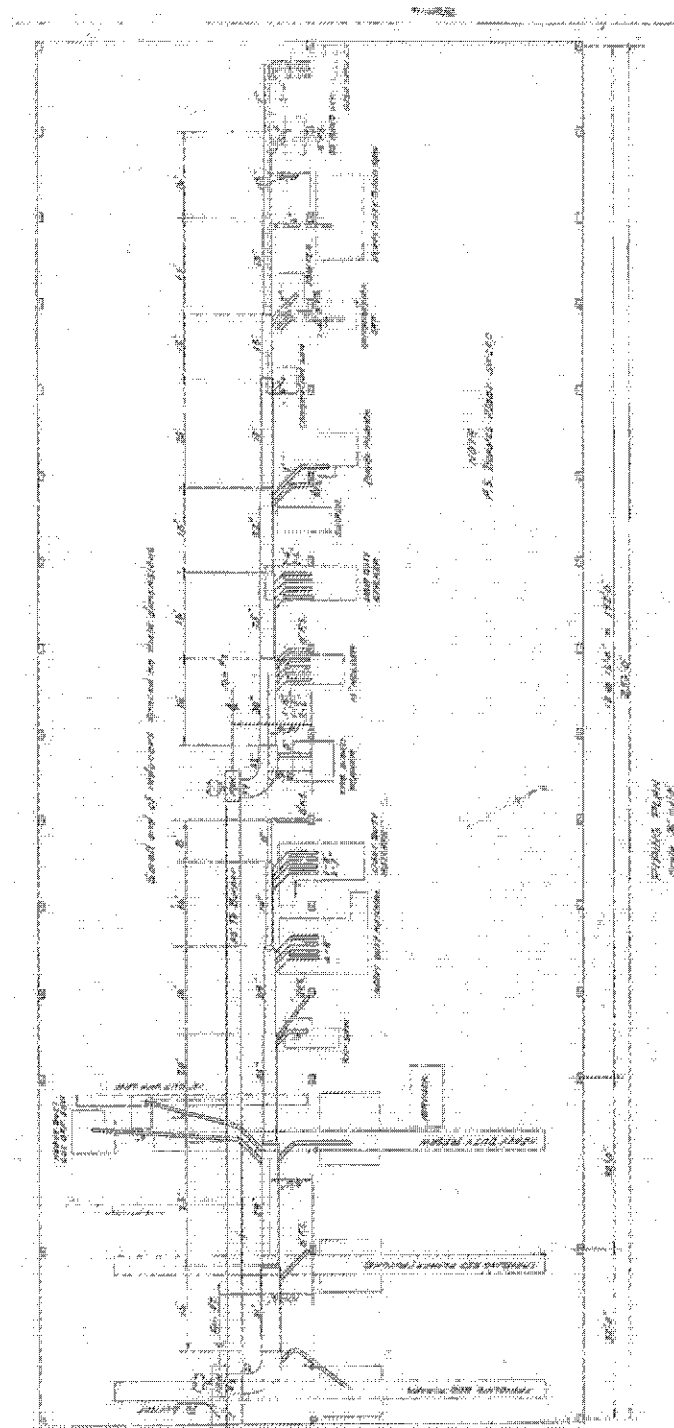
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Portion of photograph dated 23 May 1949 showing Building 154 with rooftop cyclone collector and incinerator at the rear. View facing east. NAVFAC Archives 23 May 1949.



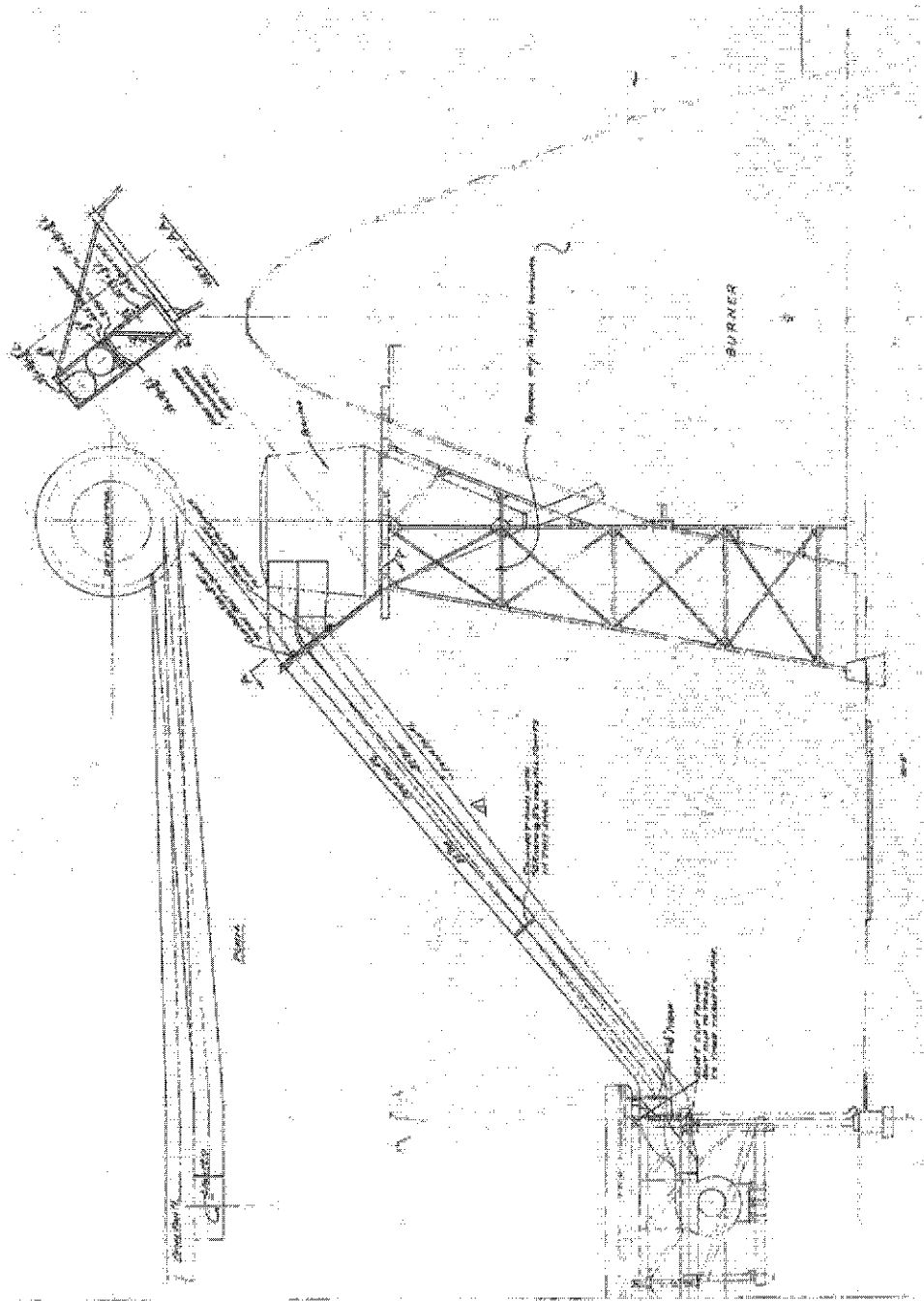
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Portion of drawing dated December 17, 1940 showing the duct work and fans of the dust collection system in Building 154. North is at the bottom of the drawing. NAVFAC drwg I-N5-306, 17 December 1941.



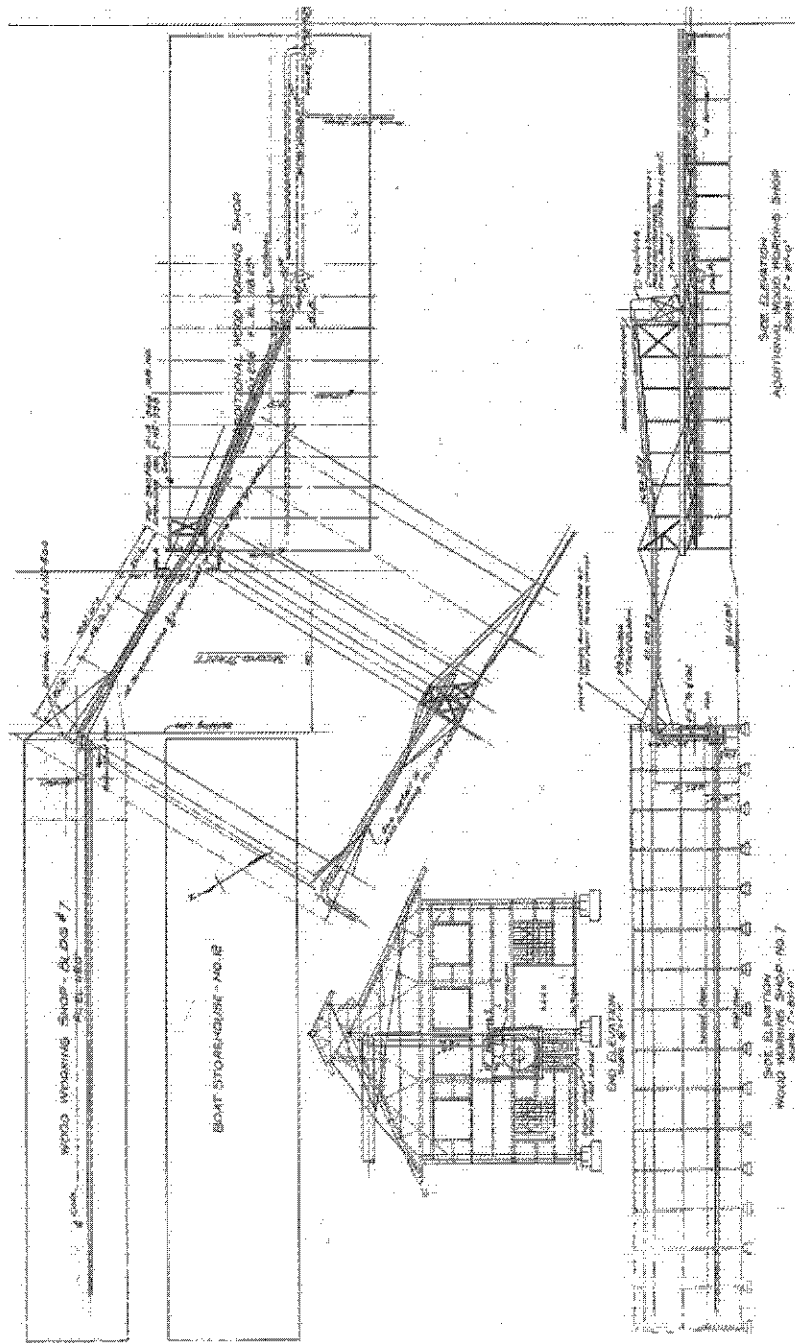
U.S. NAVAL BASE, PEARL HARBOR, SAWMILL
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Portion of drawing dated January 31, 1941 showing the incinerator and cyclone collector at the rear of Building 154. A note below the title block of the drawing states "Burner destroyed 1972." NAVFAC drwg I-N5-318, 31 January 1941.



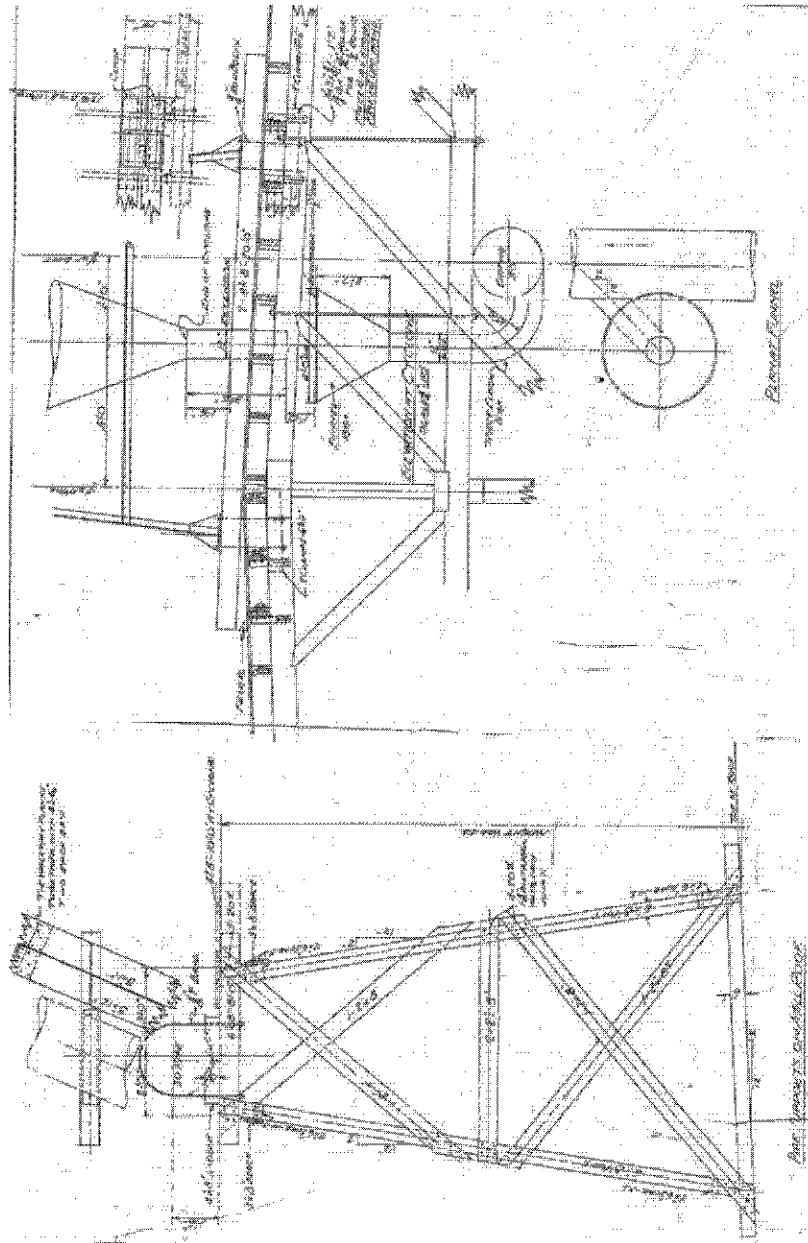
U.S. NAVAL BASE, PEARL HARBOR, SAWMILL
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Portion of drawing dated August 5, 1941 showing the connection of the added dust collection system in Building 7 (left) to the existing system in Building 154 (right).
NAVFAC drwg I-N5-396, 5 August 1941.



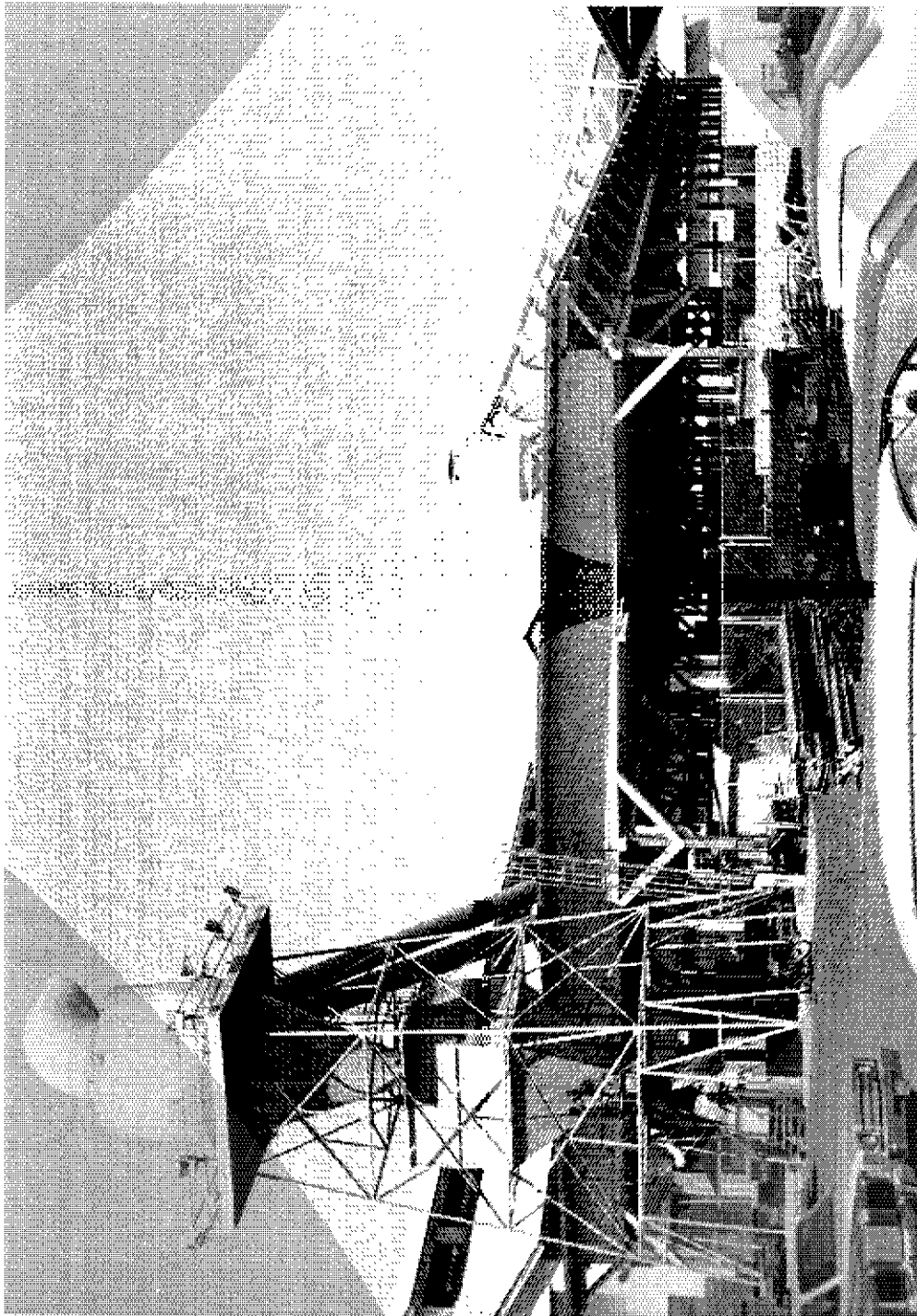
U.S. NAVAL BASE, PEARL HARBOR, SAWMILL
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Portion of drawing dated August 5, 1941 showing a typical duct support on the roof of Building 154 and a detail of the discharge chute and funnel of the cyclone collector.
NAVFAC drwg I-N5-399, 5 August 1941.

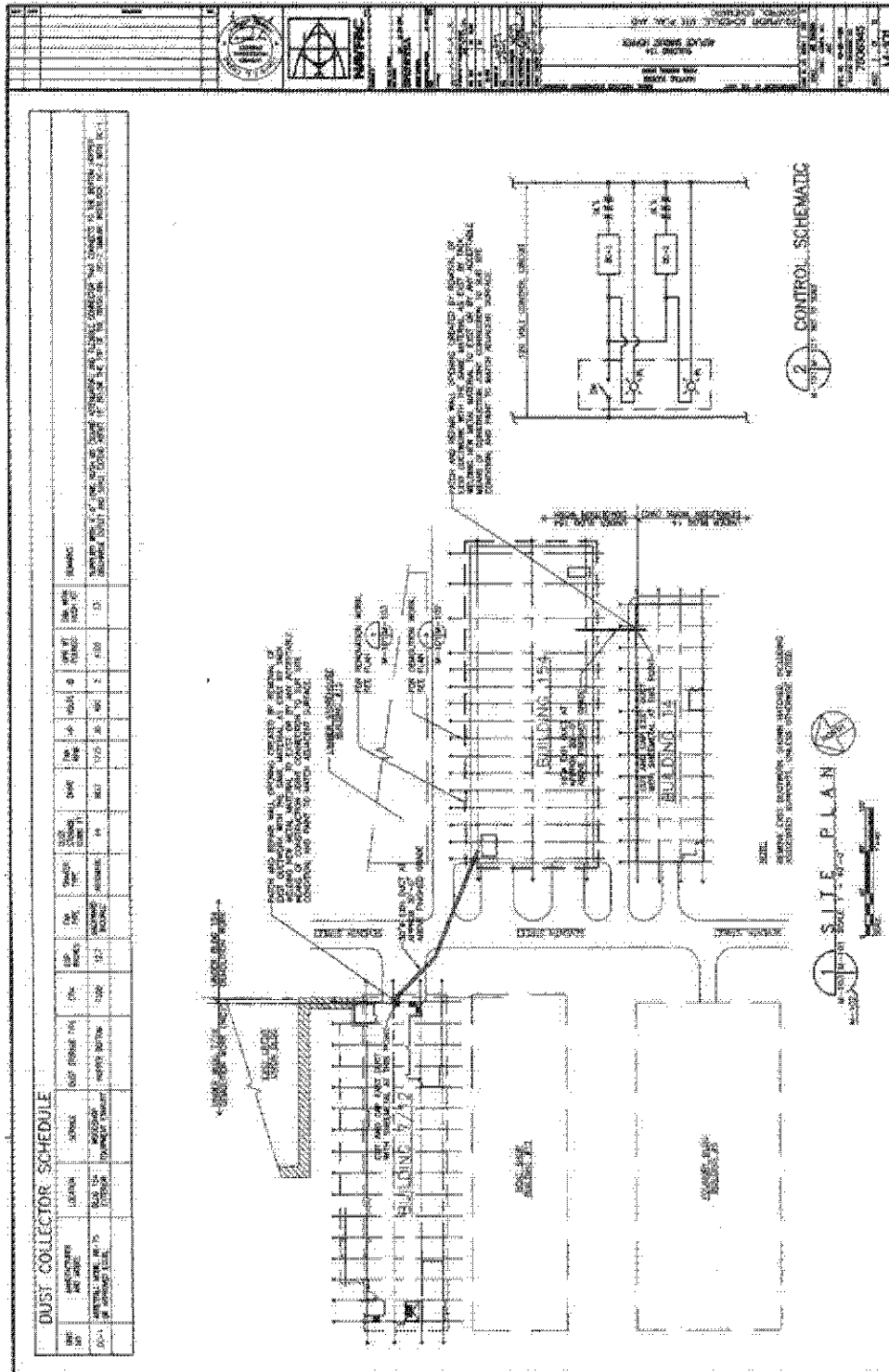


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Photo dated March 1980 showing the cyclone collector at the rear of Facility 154. Note the cyclone collector on the roof of the building and the ductwork leading to Facility 7. NAVFAC Archives # VSJ-74-3-80 F146.



Portion of drawing dated March 2006, showing renovation of the dust collection system in Buildings 154, 7, and 14. NAVFAC drwg 7506345, 26 March 2006.



Portion of drawing dated March 2006, showing renovation of the dust collection system in Building 154. NAVFAC drwg 7506346, 26 March 2006,.



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Portion of drawing dated March 2006, showing renovation of the dust collection system in Building 154. NAVFAC drwg 7506347, 26 March 2006.

